

# Exceptional Points in Systems with Competing Nonlocal Nonlinearities



## Oral Qualifying Exam Presentation

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### Venue

Conference Room: Physics Library

Knight Physics Building

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### Abstract:

Solitons are localized waves that maintain their shape through a balance between diffraction and nonlinearity. In many optical media, this nonlinearity is nonlocal and can involve competing effects such as self-focusing and self-defocusing, leading to richer and less intuitive dynamics. In this work, we study vector solitons, where multiple fields interact and propagate together. We find that, in systems with competing nonlocal nonlinearities, these solitons can exhibit unusually large-amplitude oscillations. To understand this behavior, we map the system to an effective particle model using Ehrenfest's theorem. This allows us to describe soliton interactions in terms of masses and coupling constants, providing a simple mechanical picture of the dynamics. We identify a special regime where the coupling becomes nonreciprocal, leading to exceptional-point-like behavior. Near this regime, even small perturbations can produce large oscillations, revealing how complex and highly sensitive dynamics can arise even in fundamentally Hermitian nonlinear optical systems.

